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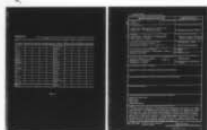
SUBJECTIVE EVALUATION OF THE EFFECTS OF SLEEP LOSS: THE NPRU MO--ETC(U)  
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THE NPRU MOOD SCALE

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SUBJECTIVE EVALUATION OF THE EFFECTS OF  
SLEEP LOSS: THE NPRU MOOD SCALE

J. M. Moses, A. Lubin, P. Naitoh, and L. C. Johnson

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### Abstract

A mood scale consisting of 52 adjectives and phrases was given to twelve young naval recruits to determine which items were sensitive to at least one night of sleep loss. The items which were maximally sensitive to sleep loss were then used to measure the effects of one night of total sleep loss in another group of fourteen young naval recruits. The two experiments resulted in a list of 29 adjectives and short phrases, the NPRU Mood Scale. This scale can be easily, briefly, and repeatedly employed to detect cumulative sleep loss and to assist in evaluating task performance decrement.

DESCRIPTORS: Adjective check list, Mood scale, Sleep loss, Task performance. (J. M. Moses)

SUBJECTIVE EVALUATION OF THE EFFECTS OF  
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J. M. Moses, A. Lubin, P. Naitoh, and L. C. Johnson

Most sleep deprivation studies have been concerned primarily with the evaluation of performance and of the quality and quantity of sleep, but the development of sensitive valid psychological tests of the subjective effects of sleep loss has been given less attention.

An early study (Murray, Williams, & Lubin, 1958), in which Ss rated themselves on a four-point scale, found significant increases in self-ratings of sleepiness and fatigue, but only after two or three nights without sleep. Recently, Hoddes, Dement, and Zarcone (1972) published the Stanford Sleepiness Scale (SSS). The SSS, which consists of seven statements representing decreasing levels of arousal, is sensitive to one night of sleep loss (Hoddes, Zarcone, Smythe, Phillips, & Dement, (1973).

Thayer (1967, 1970, 1971) and others (e. g., Hendrick & Lilly, 1970; Bohlin & Kjellberg, 1973) have developed and factor analyzed Multiple Adjective Check Lists (MACLs) designed to measure changes in activation, stress, contentment, depression and hostility. These studies reported significant changes in at least one factor following one night of sleep loss.

The purpose of this paper is to describe a self-rating MACL, the NPRU Mood Scale. It is a brief and easily administered list of 29 adjectives and short phrases designed to measure mood changes due to one or more nights of sleep loss.

The need for this short test became apparent to us after analysis of the mood data in our recent study of sleep stage deprivation and total sleep deprivation (Johnson, Naitoh, Moses, & Lubin, 1974). In that study, several self-report mood questionnaires were used: an early 52-item version of the Profile of Mood State (POMS) by McNair, Lorr, and Droppleman (1971); the current 65-item version of the POMS; the Primary Affect Scale (PAS) (Johnson & Myers, 1967); and the Spielberger State-Trait Anxiety Inventory (STAI) (Spielberger, 1968). Despite the considerable overlap among these tests, the usual scoring methods produced inconsistent and sometimes contradictory results in describing mood changes after sleep loss.

#### METHOD

The NPRU Mood Scale was developed from an experiment (Lubin, Moses, Johnson, & Naitoh, 1974) in which twelve naval recruits, ages 17-21, were deprived of two nights of sleep after a baseline of four days. The original 52-item adjective check list (the early version of the POMS) from which the NPRU Mood Scale was derived was administered at the same time twice each day. The subjects chose one of four possible responses to each item ranging from "not at all" (scored as 0) to "extremely" (scored as 3). Scores were obtained on six mood categories: anxiety-depression, fatigue, hostility, friendliness, energy, and happiness-satisfaction. Category scoring, however, was tedious, time-consuming, and not all the factors were sensitive to sleep loss.

We, therefore, constructed our own mood score, in such a way that it was maximally sensitive to sleep loss. The first step was to decide a priori which items were "positive" (e. g., satisfied, cheerful, efficient--all of which were predicted to decrease during sleep loss), and which items were "negative" (e. g., sleepy, unhappy, depressed--all of which were predicted to increase during sleep loss). Of the 52 items, 21 were judged positive and 31 were judged negative. We then tabulated the sum of the positive items and the sum of the negative items. A test for trend during the four baseline days showed no significant<sup>1</sup> increase or decrease in the positive or negative scores. The baseline scores were therefore combined into an average positive score and an average negative score. The positive and negative sums were then tested for sensitivity to sleep loss by subtracting the baseline average score from the score after one night of sleep loss.

Of the 31 negative items, 21 increased as predicted, but the increase over baseline was not significant. Nineteen of the 21 positive items decreased after one night of sleep loss, and this decrease from the baseline average was significant ( $\bar{D} = -5.0$ ;  $s = 7.4$ ;  $N = 12$ ). Additional analyses showed that P, the sum of the sensitive 19 positive items, was a better measure of one night of sleep loss than any weighted combination of the positive and negative items. These 19 positive items (active, alert, carefree, cheerful, able to concentrate, considerate, dependable, efficient, friendly, full of pep, good-natured, happy, kind, lively, pleasant, relaxed, satisfied, able to think clearly, able to work hard) were therefore used as the mood score in Experiment 2.

At the .05 level of significance, the statistical power of the Mood Scale is such that for 8 Ss, there is a 50% chance of finding a significant sleep loss effect; for 25 Ss, there is a 95% chance of finding a significant effect.

#### Cross-Validation Study

The fourteen naval recruits in Experiment 2 (ages 18-21) were tested for four baseline days, and then underwent three nights of either stage 4 deprivation (N=7) or stage REM deprivation (N=7). The sleep stage deprivation was followed by one night of total sleep loss, and two recovery nights. (For a complete description of tests and methods used, see Johnson et al., 1974).

#### RESULTS

Student's t, backed by Wilcoxon's rank tests, was used for all tests of significance.

After one night of total sleep loss (plus 3 nights of differential sleep stage deprivation), both groups showed similar and significantly lower P scores, with an average drop of 7.3 points ( $s = 6.3$ ;  $p < .001$ ). Both groups returned to the baseline level after the first recovery sleep. The results are summarized in Table 1.

Table 1  
about  
here)

There were no significant differences between the REM-deprived and stage 4-deprived groups on any day. Both groups received lower P scores after three nights of sleep stage deprivation; the decrement from baseline was significant for the REM-deprived group. The sleep loss incurred during stage 4 deprivation was minimal. For the REM-deprived Ss, however, there was a cumulative sleep loss of about 200 min by the end of the third deprivation night. Thus, our Mood Scale was sensitive to a relatively small amount of sleep loss such as that accumulated during REM deprivation.

## DISCUSSION

Subjective changes in mood after total sleep loss can be more sensitive than performance deficit or changes in quantitative indices of sleep behavior. Examination of the data of Experiment 1 (Lubín et al., 1974), showed that the Mood Scale, which requires about a minute to complete, was more sensitive to one night of sleep loss than the 20-min Word Memory Test or the 60-min X Crossout Test, but less sensitive than a 50-min counting task, a 60-min addition test, or a 50-min auditory vigilance test.

While the NPRU Mood Scale was designed to assess the effects of experimentally imposed sleep loss, clearly it can measure sleep loss regardless of cause and may offer an easily administered yet sensitive technique for assessing sleep loss effects in any context. Another important feature of the NPRU Mood Scale is that it lacks the learning factors common to many performance tests and therefore can be given repeatedly without showing practice effects.

In a study of the effects of one night of sleep loss on the structure of mood, Hendrick and Lilly (1970) administered a 44-item mood scale to college students and found that the items connoting negative feelings were as sensitive to sleep loss as the positive items. The negative items were not sensitive to sleep loss for our naval recruits. The 15 Army enlisted men in the Murray et al. study (1958) did not admit to feelings of fatigue or sleepiness after one night of sleep loss, even though experimental observers reported significant increases for these Ss on a sleepiness scale and a fatigue scale. These results indicate that Ss drawn from a military population are less likely than college students to admit increased feelings of fatigue, tension, or anger.

To broaden its applicability, the NPRU Mood Scale was buffered with ten negative items from Experiment 1 and from the Hendrick and Lilly study. These negative adjectives (annoyed, defiant, drowsy, dull, grouchy, jittery, sleepy, sluggish, tense, tired) were sensitive to sleep loss for one or both studies. Fig. 1 gives the final form of the NPRU Mood Scale.

(Fig. 1  
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Scoring. Each of the four possible response categories is assigned a weight: "not at all," 0; "a little," 1; "quite a bit," 2; "extremely," 3. The sum of the responses to the 19 positive items is the P score. The sum of the responses to the 10 negative items is tabulated in the same way to obtain the N score. Combining the P and N scores is not recommended since the sensitivity of the N score to sleep loss is not conclusive.

#### Footnotes

- <sup>1</sup> In this paper, significance means .05 level or better, one-tail test, unless otherwise noted.

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TABLE 1

P Scores<sup>a</sup> on the NPRU Mood Scale

| Group                     | Baseline           |             | Stage Dep.<br>3 | Total<br>Sleep<br>Loss | Recovery    |              |
|---------------------------|--------------------|-------------|-----------------|------------------------|-------------|--------------|
|                           | 1                  | 2           |                 |                        | 1           | 2            |
| REM-<br>deprived<br>(N=7) | M= 34.6<br>SD= 8.4 | 32.3<br>6.1 | 29.4*<br>7.1    | 25.9*<br>9.5           | 32.0<br>9.7 | 35.1<br>10.1 |
| S4-<br>deprived<br>(N=7)  | M= 31.9<br>SD= 4.6 | 29.9<br>7.7 | 27.9<br>6.2     | 23.9**<br>6.0          | 29.6<br>6.0 | 28.4<br>7.5  |

<sup>a</sup>P scores range from 0 (extremely sleepy) to 57 (extremely active)\*  $p < .05$ \*\*  $p < .01$

NPRU MOOD SCALE  
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Instructions: For each item, choose one of the four answers that best describes how you feel now. Then put an "X" in that box.

| NAME _____            |            |          |             |           | AGE _____             | SEX _____  | DATE _____ |             |           |
|-----------------------|------------|----------|-------------|-----------|-----------------------|------------|------------|-------------|-----------|
| ITEM                  | NOT AT ALL | A LITTLE | QUITE A BIT | EXTREMELY | ITEM                  | NOT AT ALL | A LITTLE   | QUITE A BIT | EXTREMELY |
| ACTIVE                |            |          |             |           | GOOD-NATURED          |            |            |             |           |
| ALERT                 |            |          |             |           | GROUCHY               |            |            |             |           |
| ANNOYED               |            |          |             |           | HAPPY                 |            |            |             |           |
| CAREFREE              |            |          |             |           | JITTERY               |            |            |             |           |
| CHEERFUL              |            |          |             |           | KIND                  |            |            |             |           |
| ABLE TO CONCENTRATE   |            |          |             |           | LIVELY                |            |            |             |           |
| CONSIDERATE           |            |          |             |           | PLEASANT              |            |            |             |           |
| DEFIANT               |            |          |             |           | RELAXED               |            |            |             |           |
| DEPENDABLE            |            |          |             |           | SATISFIED             |            |            |             |           |
| DROWSY                |            |          |             |           | SLEEPY                |            |            |             |           |
| DULL                  |            |          |             |           | SLUGGISH              |            |            |             |           |
| EFFICIENT             |            |          |             |           | TENSE                 |            |            |             |           |
| FRIENDLY              |            |          |             |           | ABLE TO THINK CLEARLY |            |            |             |           |
| FULL OF PEP           |            |          |             |           | TIRED                 |            |            |             |           |
| DO NOT FILL IN SCORES |            |          |             |           | ABLE TO WORK HARD     |            |            |             |           |

Fig. 1

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